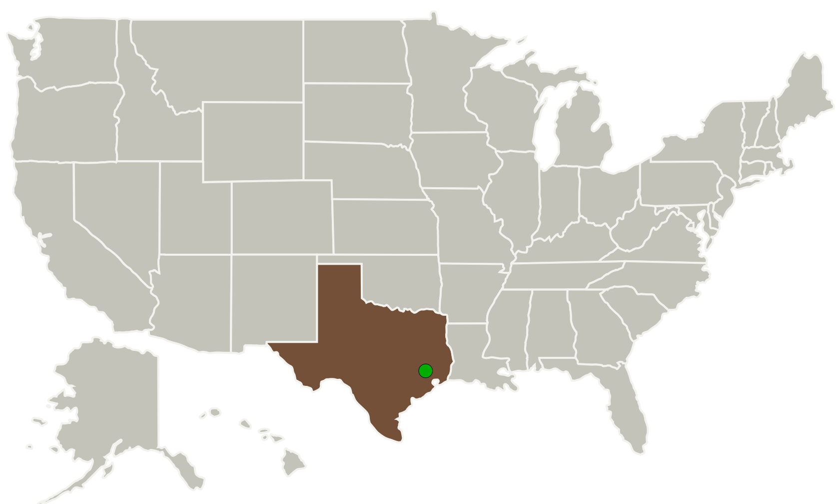
Thioaptamer Diagnostic System, Phase II

Completed Technology Project (2010 - 2013)

Project Introduction

AM Biotechnologies (AM) in partnership with Sandia National Laboratories will develop a Thioaptamer Diagnostic System (TDS) in response to Topic X10.01 Reusable Diagnostic Lab Technology. The TDS will quickly quantify clinically relevant biomarkers in flight using only microliters of virtually any complex sample. The system combines ambient-stable, long-shelf-life affinity agent assays with a handheld microfluidic gel electrophoresis affinity assay quantification technology. The system is easy to use, compatible with operation in microgravity, and designed to permit simultaneous quantification of 32 or more biomarkers from a single astronaut sample. Phase 1 of this project demonstrated that a thioaptamer assay used in the microfluidic instrument can quantify a specific biomarker in serum in the low nanomolar range. AM also successfully identified novel affinity agents to bone specific alkaline phosphatase (BAP) and demonstrated their use to detect BAP using the microfluidic instrument. Phase 2 will expand the number of ambient stable affinity agents and demonstrate a TDS prototype to NASA. AM anticipates that the TDS at the end of Phase 2 will be at TRL 4 to 5. In Phase 3, AM and Sandia will produce flight units for NASA research use on the International Space Station (ISS) as well as for diagnostic use on future long duration missions.

Primary U.S. Work Locations and Key Partners



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Organizations Performing Work	Role	Type	Location
AM Biotechnologies, LLC	Lead Organization	Industry	Houston, Texas
Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Primary U.S. Work Locations
Texas

Project Transitions

June 2010: Project Start

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

AM Biotechnologies, LLC

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

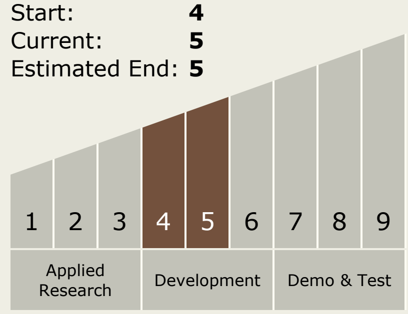
Carlos Torrez

Principal Investigator:

Xianbin Yang

Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



June 2013: Closed out

Closeout Summary: This Phase I project Summary will be formatted as a serie s of summary statements, with additional comments. The summary statements are intended to focus on the most significant findings and discoveries – things th at the project team knows now, but we didn't know at the beginning of the proje ct. 1) Direct Contact Between Gases is an ECLS System enabling capability. The Phase 1 project focused on CO2 capture, using direct contact of gases and liquid s to facilitate the kinetics of solubility based absorption. At the beginning of the project, we were thinking about the CO2 capture application, but we were not th inking about ECLS system level impacts. In the course of the phase 1 effort, we realized that many fundamental unit processes in biological and chemical syste ms (absorption, evaporation, transpiration, distillation, condensation) need direc t contact between a gas phase system and a liquid phase system. Capillary tech nology that enables gas absorption into a liquid helps all ECLS processes that in volve gas absorption – it also enables evaporation, transpiration, distillation, an d condensation. Fluid management capability is more broadly applicable than we had originally thought. 2) CO2 capture using liquid sorbents in microgravity is fe asible. The phase I project set out to assess feasibility of the CO2 capture applic ation. Liquid pumping rates are sufficient, high viscosity is tolerable, contact are a is sufficient, flow distribution networks are initially large, but there are design paths to reduce system size. It is feasible to use direct gas/liquid contact for CO 2 capture, and with the right designs and sufficient development, these systems promise to be smaller, more power efficient, and more reliable that current syst ems. 3) There are other ways to contact gases and liquids – but thin film capillar y techniques are new, exciting, and have amazing potential. As a result of this p hase I project, we are able to put thin film contactors in context with other fluid management systems. Once placed in context, the power and significance of thi n film contact becomes apparent. Two existing methods of gas/fluid manageme nt are membrane contactors, and wet spray reactors. Membrane contactors hav e nearly perfect liquid containment, but unacceptably slow kinetics. Wet spray c ontactors have great kinetics, but no gas/liquid containment. In the balance bet ween kinetics and containment, thin film contactors are in the "goldilocks zone" – they have sufficient kinetics and sufficient control. This is new and potentially powerful. 4) ECLS system reliability is the key to exploration missions – the key to reliability is having system attributes that favor reliability Slow moving, gentl y sweeping, uniform rate, ambient temperature, ambient pressure systems are more likely operate reliability than systems that involve vacuum systems, high t emperatures, hazardous chemicals, and transient operating conditions. If missio n planners place a priority on system reliability, ECLS system developers should focus on processes that have the attributes of reliability. 5) The processes with f avorable reliability attributes tend to be biological. Biological systems tend to be ambient temperature, ambient pressure, free of hazardous chemicals, operate a t a steady rate, and have the attributes of reliable systems. If Mission Planners want a reliable ECLS systems, then ECLS system developers should increase the technical maturity of biological systems. Biological wastewater processes can cre dibly achieve >98% recovery of water from wastewater. Biological algae based s ystems can credibly achieve >75% oxygen from CO2. 6) The single greatest im pact on launch mass of an ECLS system is water. The best way to enable biologi cal water processing is to develop a capillary based method of urine capture that doesn't use pretreat chemicals. The ISS potty uses a rotary phase separator tha t needs strong pretreat chemicals to prevent biofouling and clogging caused by precipitate build up. These pre-treat chemicals, by design, are intended to kill all microorganisms. Rotary phase separators and biological wastewater systems are

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems
  - └ TX06.3 Human Health and Performance
    - └ TX06.3.1 Medical Diagnosis and Prognosis

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System